DENTAL TECHNIQUES

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The Practice of Root Canal Fixative Methods Using Calcium Hydroxide

Foundation - Oral Health Association of Japan

2. Purpose of Fixatives

1) After pulpectomy procedure

(1) Induction of hard tissue

Much as vital pulpotomy or direct pulp capping have long been given clinical application, the fact that $Ca(OH)_2$ has the ability to induce hard tissue is common knowledge, and we simply applied this effect to the apical area as well. We may say that it is an utterly obvious, natural objective.

(2) Analgesic action

① The pH of a saturated aqueous solution of calcium hydroxide is a strong alkaline of 12.4, and when it infiltrates residual pulp tissue of the apical area or the affected apex by passing through an apical foramen or lateral branch, or a dental tubule, is regarded as producing an analgesic effect by inhibiting the work of the Pain Producing Substance (PPS) which is a pain producing factor and which changes the pH of the area to alkali.

② When an excess of Ca ions are freed, it acts to inhibit the nerve pharmacologically, so it produces an analgesic effect. In fact, clinically speaking, compared to the traditional root canal fixative method centered around FC, there is extremely little post-operative pain.

(3) Hemostatic action

① When calcium hydroxide comes into direct contact with dental pulp tissue, a necrotic layer is formed. Specifically, since proteins are dissolving because of the high pH and strong alkaline, blood vessels and blood cells also dissolve, leaching in that area, and they form a topmost necrotic surface layer. Therefore, as the necrotic layer spreads, hemostasis becomes certain. However, in some cases partial hemorrhaging continues and forms blood clots above the calcium hydroxide layer, and the formation of granulation tissue can be observed histopathologically.

② As concerns the trace amount of Ca ions in blood, if it is insufficient, the formation of thrombin from prothrombin is inhibited, and it becomes difficult for blood to clot. It is unclear whether Ca ions act on hemostasis after pulpectomy procedures, but it appears to promote a heightened hemostatic effect.

(4) Arresting effusion

① When calcium hydroxide powder is fixed inside the root canal, since it has water absorbing properties, it takes the effusion into the powder and the effusion is arrested.

② Due to the highly alkaline property of calcium hydroxide, a necrotic layer is formed in locations in contact with the effusion and it gradually arrests the effusion.

③ When Ca ions increase, the permeability of capillary walls lessens, and the amount of the effusion also decreases.

(5) Dissolution of residual pulp tissue

① Since it is highly alkaline with a pH of 11-12, it dissolves proteins.

② By polishing $Ca(OH)_2$ paste to be somewhat pliable, it promotes the dissolution of residual pulp tissue.

(6) Sterilizing action

① In theory, at the time of a pulpectomy procedure, micro-organisms are not present within the apical area canal, but bacteria at the root canal opening may infect the apical area through human action. In such an event, sterilization will be necessary even in pulpectomy cases.

② "No micro-organism is capable of surviving in the harsh environment of a pH of 12" i.e., $Ca(OH)_2$ paste has an ongoing sterilizing action. However, the amount of micro-organisms and the duration of the effect are important factors. Specifically, we must adhere to the following conditions.

a. Fix as much $Ca(OH)_2$ as possible inside the root canal.

b. Fix for at least one week.

(7) Cleaning action on root canal walls

Due to the high pH and strong alkaline, it dissolves the residual dental pulp tissue of odontoblast cells, nerves, blood vessels, and so on.

2) During Treatment of Infected Root Canals

(1) Sterilizing action

① Is sterilization of the apical area possible?

a. Within the root canal, it should be just narrowly possible.

b. It is extremely challenging [to sterilize] micro-organisms adhering to the surface of the apical area with old fixative methods, but in the $Ca(OH)_2$ fixative method, the pH of the surface of the apical area changes, so it would be expected (Fig. 14).

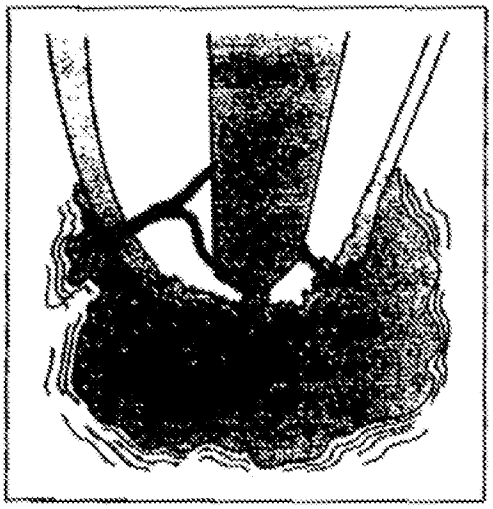

Fig 14 – Sterilization within the root canal of the apical area can be managed, but sterilization of the root surface or within the lesion is extremely challenging.

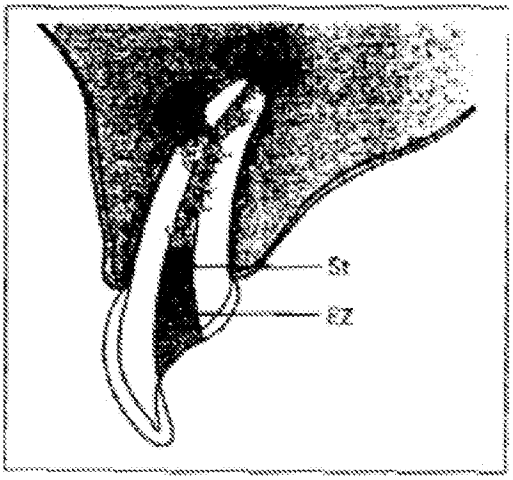

Fig 15 – Altering the pH at a point of external absorption is easy.

② Why is it possible to sterilize with $Ca(OH)_2$?

a. It has a pH of 11-12 and is highly alkaline.

b. It dissolves the proteins of micro-organisms.

c. The OH ions of $Ca(OH)_2$ permeate every crevice of the root canal (Figs. 15, 16).

d. It necrotizes cells upon contact.

③ How long does the sterilizing action continue?

a. Inside experimental canals, there was almost no change in the pH of the calcium hydroxide paste even after the passage of more than four months.

b. The pH of calcium hydroxide paste fixed within the canal does not change even after the passage of three weeks.

(2) Dissolution of residual contaminants

① Nothing can be done about inorganics, but organics dissolve since the pH is 11-12.

② Though a secondary effect, it facilitates removal of inorganics.

③ Polishing $Ca(OH)_2$ paste to be somewhat pliable makes the removal of residual contaminants easier.

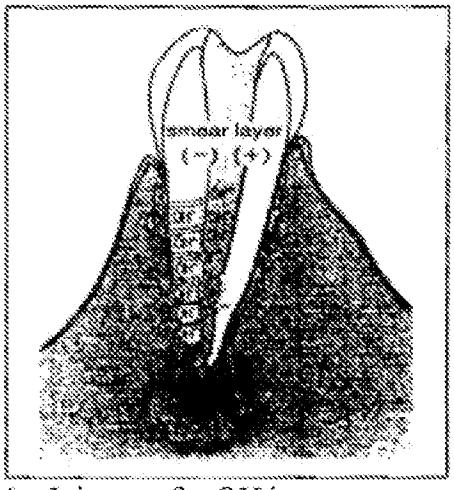

Fig. 16 – It is easy for OH ions to permeate the root surface from root canal walls from which a smear layer has been removed.

(3) Inhibition of effusion

① Differs depending on the state of the apical area lesion.

② Absorbs the effusion through the application of $Ca(OH)_2$ powder.

③ Due to the permeation of OH ions into the lesion area, inflammation is assuaged by the change in pH of the lesion area, and cells activate, reducing the effusion.

④ Ca ions are freed, and act on capillaries which distribute them to the area of the lesion, and they promote the reduction of the effusion.

⑤ The root canal fixative occurs frequently. There are many cases where it reaches the long-term.

(4) Analgesic action

① Differs depending on the degree of inflammation of the apical area.

② Effective with the ache of the root membrane period of acute apical periodontitis or the pain of chronic apical periodontitis.

③ In cases of marked pus discharge or hemorrhaging, perform the root canal open therapy, then after alleviating acute symptoms fix the $Ca(OH)_2$ paste.

④ In cases where pain on percussion persists, do a long term fixation of wet $Ca(OH)_2$ paste.

⑤ The mechanism of the action inhibits the working of pain producing factors through the strongly alkaline properties of $Ca(OH)_2$. Also it gives rise to an analgesic action by Ca ions working on the nerves.

(5) Induction of hard tissues

① As in cases following a pulpectomy procedure, the induction of hard tissues is challenging, but it would be fully expected with examples of long-term fixatives.

② Significant results can be achieved particularly in the case of incomplete apical foramen teeth.

③ How OH and Ca ions for the lesion area act on cells, blood vessels, and nerves in the area is extremely interesting. Surprisingly, tooth bud tissue and dental pulp may be the same.